

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
21 October 2004 (21.10.2004)

PCT

(10) International Publication Number  
**WO 2004/090568 A1**

(51) International Patent Classification<sup>7</sup>: **G01S 17/36**

(21) International Application Number:  
PCT/NZ2004/000070

(22) International Filing Date: 6 April 2004 (06.04.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
525241 8 April 2003 (08.04.2003) NZ

(71) Applicant (for all designated States except US): **THE UNIVERSITY OF WAIKATO** [NZ/NZ]; Gate 5, Hillcrest Road (no number), Hamilton, 2001 (NZ).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **DORRINGTON, Adrian, Andrew** [NZ/NZ]; 48c Paterson Street, Dinsdale, Hamilton, 2001 (NZ).

(74) Agents: **MURPHY, Simon, J** et al.; Private Bag 3140, Level 12, KPMG Centre, 85 Alexandra Street, Hamilton, 2001 (NZ).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

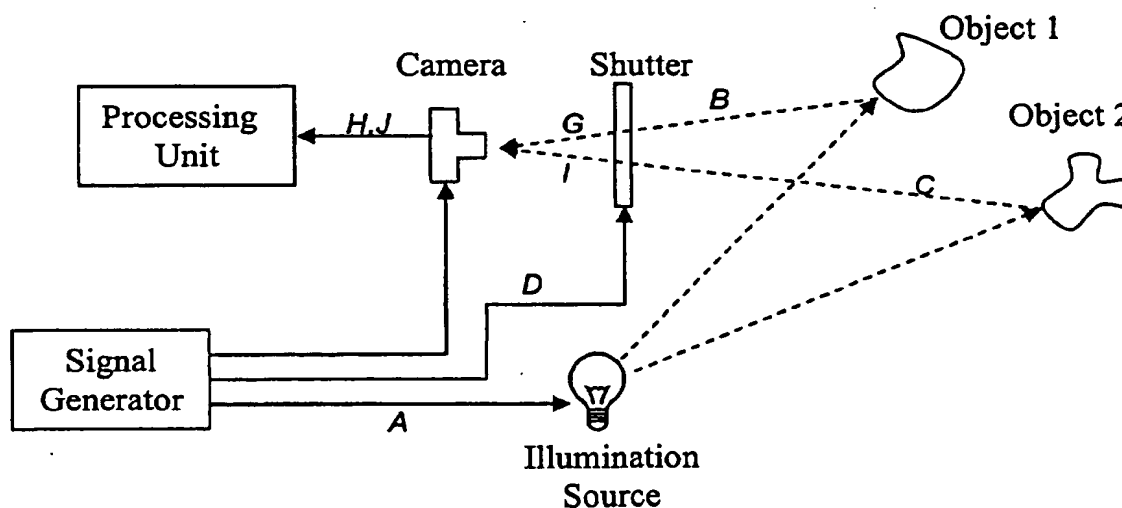
Published:

- with international search report
- with amended claims

Date of publication of the amended claims: 18 November 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: RANGE SENSING SYSTEM



(57) Abstract: The invention relates to a range sensing system. An energy source is adapted to emit energy which is capable of reflection by a target. The energy source is activated and deactivated in a cyclic pattern with a selected source frequency. A receiver is adapted to sense the reflection of emitted energy from the target. The receiver includes a shielding system to block the sensing of reflected energy from the target in a cyclic pattern with a selected receiver frequency. The output signal of the receiver is compared with a reference signal whereby the phase differences between the receiver signal and reference signal is used to determine a range value.

**AMENDED CLAIMS**

**[Received by the International Bureau on 23 August 2004 (23.08.2004) ;  
original claims 1 – 25, replaced by amended claims 1 – 24]**

1. A range sensing system which includes:

at least one energy source adapted to emit energy capable of reflection by one or more targets within a region, and

at least one receiver adapted to sense the reflection of emitted energy from said at least one target within said region, and

an activation system associated with said at least one energy source, said activation system being adapted to activate and deactivate an energy source in a cycle pattern with a selected source frequency, and

a shielding system associated with said at least one receiver, said shielding system being adapted to block the sensing of reflected energy from a target by a receiver, said shielding system being activated and deactivated in a cyclic pattern with a selected receiver frequency, said source frequency and receiver frequencies being selected from different frequency values,

wherein an output signal of a receiver is compared with a reference signal to determine a range value for a selected target of the receiver, where phase differences between the receiver signal and reference signal indicate a range value.

2. A range sensing system as claimed in claim 1 adapted to indicate range values for a plurality of targets within a region.
3. A range sensing system as claimed in claim 1 or claim 2 wherein the source frequency used is phase locked with respect to the receiver frequency used.

4. A range sensing system as claimed in claim 3 wherein a single signal generator generates a receiver frequency which is phase locked with respect to a source frequency generated by the same signal generator.
5. A range sensing system as claimed in any one of claims 2 to 4 wherein an output signal of a receiver has a frequency equal to the frequency difference between a source frequency and a receiver frequency.
6. A range sensing system as claimed in any previous claim wherein said at least one energy source is activated and said at least one receiver is shielded using a plurality of paired source and receiver frequencies.
7. A range sensing system as claimed in claim 6 wherein a receiver is adapted to emit a plurality of output signals in response to the use of said plurality of paired sets of source and received frequencies.
8. A range sensing system as claimed in any previous claim which includes a single energy source only with a diffuse emission pattern.
9. A range sensing system as claimed in any previous claim wherein an energy source is formed from a light emitting diode.
10. A range sensing system as claimed in any previous claim wherein an energy source emits visible light energy.
11. A range sensing system as claimed in claim 10 wherein a receiver is formed from a light sensitive transducer.
12. A range sensing system as claimed in claim 11 wherein the receiver is formed from or implemented by a charged coupled device.

13. A range sensing system as claimed in any previous claim wherein the range sensing system includes a single receiver only.
14. A range sensing system as claimed in any previous claim wherein the activation system controls the supply of power to an energy source.
15. A range sensing system as claimed in any previous claim wherein the shielding system is implemented through a physical barrier.
16. A range sensing system as claimed in any one of claims 1 to 15 wherein the shielding system is implemented through an enable signal applied to operate a receiver.
17. A range sensing system as claimed in any previous claim wherein the reference signal is generated by mixing the receiver frequency and the source frequency.
18. A range sensing system as claimed in any one of claims 1 to 17 wherein the reference signal is generated through a calibration procedure.
19. A range sensing system as claimed in any previous claim wherein the range sensing system includes a processing means adapted to compare an output signal of the receiver to a reference signal.
20. A range sensing system as claimed in claim 19 wherein the processing means is a computer system.
21. A method of calculating a range to a target within a region, characterised by the steps of:
  - (i) activating an energy source using an activation system, said energy source being activated and deactivated in a cyclic pattern with a selected source

frequency, and

- (ii) operating a receiver using a shielding system, said shielding system being adapted to block the sensing of reflected energy from a target in a cyclic pattern with a selected receiver frequency, said source frequency and receiver frequency being selected from different frequency values, and
  - (iii) comparing a receiver output signal with a reference signal to determine a range value for said target, where phase differences between the receiver output signal and reference signal indicate a range value.
22. A method of calculating a range to a target within a region as claimed in claim 21 wherein the energy source is activated and the receiver is shielded using a plurality of paired source and receiver frequencies.
23. A range sensing system substantially as herein described with reference to and as illustrated by the accompanying drawings and/or examples.
24. A method of calculating a range to a target within a region substantially as herein described with reference to and as illustrated by the accompanying drawings and/or examples.